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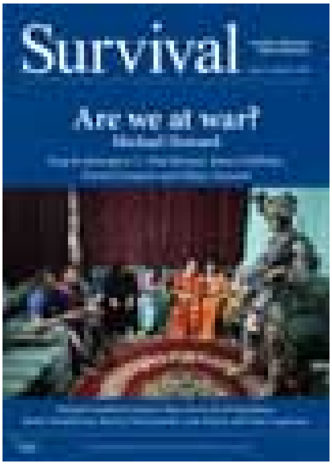

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The Impending Oil Shock: An Exchange

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Forum

The Impending Oil Shock: An Exchange

Editor's note

In the April–May 2008 issue of *Survival* (vol. 50, no. 2, pp. 37–66), Nader Elhefnawy argued that oil production is approaching its peak, with consequences that are likely to be dramatic. There will be increased risk of state failure and resource conflict; the economic balance of power among major industrial states will shift according to their relative abilities to adapt to a scarcity of fossil fuels; and oil producers will enjoy greater political power. *Survival* invited two experts on strategic energy issues, Amy Myers Jaffe and Michael T. Klare, to comment on Elhefnawy's essay, and Elhefnawy to respond.

Opportunity, not War

Amy Myers Jaffe

We've heard the argument before: scarcity of future oil supplies is a danger to the global international system and will create international conflict, death and destruction. In 1982, noted historian and oil-policy guru Daniel Yergin wrote that the energy question was 'a question about the future of Western society', noting that 'stagnation and unemployment and depression tested democratic systems in the years between World War I and World War II' and asserting that if there wasn't sufficient oil to drive economic growth, the 'possibilities are unpleasant to contemplate'.[1] His words proved typical prose foreboding the top of a commodity cycle. A year later, oil prices began a four-year collapse to $12 a barrel.

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That oil is a cyclical industry is not in question. Since 1861, oil markets have experienced more than eight boom-and-bust cycles. In 1939, the US Department of the Interior announced that only 13 years of oil reserves remained in the United States. In more recent history, Middle East wars or revolutions produced oil price booms in 1956, 1973, 1979, 1990 and 2003. Each time, analysts rushed to warn of doomsday scenarios but markets responded and oil use was curtailed both by market forces and government intervention rather than by war and massive global instability. The question Nader Elhefnawy raises in 'The Impending Oil Shock' is whether this time will be different.

Elhefnawy lays out the traditional Malthusian-style crisis scenario extremely well, with interesting policy implications for the United States. He predicts an impending energy-resources crunch (based on today's geologic facts, in a similar fashion as predecessors have in past cycles) and then lays out why such scarcity will 'have profound implications at the international level' by empowering energy producers, heightening the risk of state failures, and fuelling armed conflicts. The stakes are high, he argues, because the United States, by virtue of the relatively energy-inefficient nature of its economy and high oil dependence, 'could ultimately lose its position as a world power … just as the UK's position declined along with the age of coal and steam that it [the UK] pioneered'. He concludes that in the oil-scarce world, 'a nation's ability to sustain its economy and preserve its influence will depend less on military capability and more on an ability to insulate its economy from oil shocks'.

Elhefnawy raises several vital facts. First, it is hard to develop a sustainable economy without access to energy. Secondly, key oil producers currently have elevated geopolitical power. And, thirdly, huge benefits could come to countries that pursue energy efficiency and alternative energy. But these three facts do not, in my opinion, coagulate in an end to American power or sweeping global conflict. I would argue that these basic energy facts need to be reorganised to the tune of different concerns: global inequality, climate change and sustainable development. In considering all three, the United States needs to accept more responsibility at home and play a stronger leadership role on the international stage.

As Elhefnawy points out, compared to the Japanese, Americans are certainly wasteful of energy. Americans represent 5% of the world's population but we use 33% of all the oil used for road transportation. By comparison, China, even with its growing economy, consumes only about 5% of global road-fuel production, despite a population more than four times that of the United States.

The American gluttony for oil – combined with OPEC's inability, and perhaps refusal, to provide more affordable energy – is all the more galling in social-justice terms when one considers that many other nations are stuck in abject poverty.

Access to energy services is key to alleviating poverty and an indispensable element of sustainable human development. One-quarter of the global population still has no access to electricity and some 2.4 billion people rely on traditional biomass, including wood, agricultural residues and dung, for cooking and heating. More than 99% of people without electricity live in developing regions, and four out of five live in rural areas of South Asia and sub-Saharan Africa. The health consequences of using biomass in an unsustainable way are staggering. According to the World Health Organisation, exposure to indoor air pollution is responsible for nearly two million excess deaths, primarily women and children, from cancer, respiratory infections and lung diseases, and for 4% of the global burden of disease.[2] In relative terms, biomass pollution kills more people than malaria (1.2m) and tuberculosis (1.6m) each year around the world. As staggering as this situation is, it is not poised to change. The International Energy Agency projects that, under a business-as-usual scenario, by 2030 1.4bn people *still* will not have access to electricity, while the number reliant upon biomass will increase from 2.5bn in 2006 to 2.7bn.

In global environmental terms, US energy use looms large. In 2005, the United States emitted a total of 712m tonnes of carbon, 412m tonnes of which came from petroleum use for road transport. The country emits more energy-related carbon dioxide per capita than any other industrial nation.[3] In the 1990s, the US transportation sector saw emissions of carbon dioxide grow faster than any other major sector of the US economy.[4] The US Department of Energy predicts that the transport sector will generate almost half the 40% rise in US carbon emissions projected for 2025.

Beyond environmental concerns, rising US oil imports to meet soaring national gasoline demand have also been a significant factor strengthening OPEC's monopoly power in international oil markets. US net oil imports rose from 6.79m b/d in 1991 to 10.2m b/d in 2000 while global oil *trade* (that is, oil exported from one country to another) rose from 32.34m b/d to 42.67 m b/d. In other words, the US share of the increase in global oil trade over the period was a substantial 33%. In OPEC terms, the US import market was even more significant – representing over 50% of OPEC's output gains between 1991 and 2000.

Strong US import demand not only enhances OPEC's monopoly power, it has a deleterious long-term impact on the US economy. The US oil-import bill totalled $327bn in 2007 and is expected to top $400bn in 2008.[5] This is an increase of 300% from 2002. The US oil-import bill accounted for as much as 40% of the overall US trade deficit in 2006, compared to only 25% in 2002. This rising financial burden is stoking inflation and creating ongoing challenges for the US economy, challenges one might argue will likely reduce American demand for oil for a time.

Given the large scale of US purchases, incremental US acquisitions of oil affect its overall international market price. Stated another way, the cost of each marginal barrel is higher than the price paid for that barrel, since this additional purchase affects the costs of all oil consumed. From the perspective of the United States, this constitutes an externality.[6]

The US economy is both resilient and blessed with diverse energy

On the other hand, the fact that the United States faces a rising supply curve for oil gives it monopsony power. To the extent that America, or a group of consuming countries on a comparable scale, takes concrete actions to reduce the size of its purchases, it can lower the market price of oil. This can happen by accident (as, in the past, through economic recessions) or by sound public policy, which is the preferable path and the one Elhefnawy advocates.

Still, his doomsday scenario brushes aside too easily the fact that the US economy is both resilient and blessed with diverse energy geography. There is a distinct possibility that the United States and other industrialised nations will not only develop new, even more sustainable energy technologies, but also export them to alleviate poverty in the developing world. Oil giant BP, for example, is already experimenting with a business that markets smoke-free, biopellet stoves to rural households in India, and non-governmental organisations are working to bring small-scale micro-hydro and solar energy to remote areas in Africa and Asia. A multinational effort to increase such programmes would, as Elhefnawy suggests, certainly be valuable.

While the costs of the oil shocks of the 1970s have been widely debated and varied country to country, there is no doubt that the impact was severe, causing years of economic dislocation and stagnation. In the early 1980s, the costs of the oil shocks were estimated at $1.2 trillion in lost economic growth for the seven largest industrial countries.[7] But the lesson of the 1970s oil crises was not that oil-hungry industrial nations went to war. The lesson was that markets can and do adjust without recourse to state violence. In response to the 1970s oil-price shocks, the industrialised oil-importing countries undertook various domestic, bilateral and multilateral efforts. Some worked, others did not; but none, notably, involved the militarisation of energy supplies. The energy efficiency and diversification Elhefnawy praises as better positioning other countries than the United States came about through key policy responses to the 1970s. It was non-military and highly replicable. The stimulus was an oil shortage, so it is hard to see how another shortage that would come with some warning and be known to be permanent would not stimulate even greater and more effective policy and market responses. Today's investors in alternative energy must fear the possibility that cheap oil will re-emerge. Investors in Elhefnawy's world could invest far more capital without any fear that fossil fuels would fight back.

Today, we are better equipped to deal with an oil shock than in the 1970s. We have functioning, transparent global oil-futures exchanges that allow for orderly responses to sudden changes in price. We also have a much wider range of emerging technologies for energy efficiency and alternative fuel. And, most importantly, we have the experience of managing major oil shocks through multilateral institutions for diplomacy and emergency coordination that did not exist in the 1970s. We even have existing international systems for negotiating fair-minded oil rationing through the International Energy Agency emergency systems, were it to come to that.

In sum, there are more alternative pathways and less reason to go to war over oil today than ever before. This is not to say that a major oil crisis couldn't take place or, if it did, that it might not threaten the global trading system. But, surely, a structural realisation that oil will be running out could be planned for, given the fact that the international community has successfully managed unexpected, sudden losses in fuel on several occasions.

Moreover, the United States' experience, while perhaps lacking in comparison to that of some industrialised nations, is nonetheless a promising foundation for launching new, more effective policies. After the oil crises of the 1970s, oil use in several US sectors was greatly reduced through efficiency gains and fuel switching. Around a third of US homes were heated with oil in the early 1970s, compared to around 14% today. Moreover, oil was virtually removed as a fuel for electricity production in the United States. The United States has a wide array of fuels used for electricity generation, including coal, natural gas, hydroelectric, nuclear energy, geothermal, wind, biofuels and solar. We have learned that diversity of fuels creates flexibility, resilience and supplier temperance. This ability to generate electricity without recourse to oil is our greatest asset. The United States, if it embraces technologies to fuel automobiles with electricity, could do much to reduce its dependence on oil, since that electricity can be produced from many other fuels. Israel has already announced a nationwide experiment to embrace a national system for battery-powered cars. The State of California is looking at options to promote similar technology innovation.

Currently, the transportation sector represents more than two-thirds of total US petroleum use and will generate more than 70% of the projected increase in US oil demand. The 2007 US energy bill recognises this, and even its lacklustre regulations for automobile-efficiency standards will eliminate more than 2.5m b/d of oil use by 2020. A technological breakthrough that would allow Americans to get 50 miles per gallon by 2020 would save over 6.6m b/d of oil, according to a study by the Baker Institute.

Elhefnawy's contention that the United States should be doing more to develop and use alternative energy and to enhance its energy efficiency is a good one, even if he should, like many others before him, turn out to be incorrect in his prediction that the world will run out of fossil fuels in short order. The United States needs to forge a better energy policy now and for future generations, even if peak-oil theorists are wrong and we find and recover far more oil than we are currently using.

If other high-population nations, such as China or India, join the United States in its current energy-use practices, with no new breakthroughs in efficiency or alternative technology, the global environmental consequences are unthinkable. Moreover, the global oil system, while providing an economic miracle to support industrialisation in the West and now in parts of Asia, has left a huge swathe of the global population offline. A sustainable planet requires that Americans build a better energy mousetrap, perhaps one that involves distributed energy systems that could have better applicability in the less-developed world.

But the timescale to convert infrastructure is long. The more we delay, the more facilities get replaced with conventional technologies. The International Energy Agency estimates that more than $4.3tr will need to be invested to meet the increase of 30–40m b/d of oil the world will need in 2030 beyond today's demand of 83m b/d.[8] Fifteen percent of that added demand is projected to come from the United States alone and another 24% from China. If the two countries were to get together at the highest political level and develop a concrete joint strategy to eliminate as much of that demand growth as could be reasonably achieved through efficiency and alternative energy technologies, there is no telling how many of the things predicted in Elhefnawy's article could be scoffed at in 25 years.

Notes

[1] Daniel Yergin and Martin Hillenbrand, *Global Insecurity* (Boston, MA: Houghton Mifflin Company, 1982).

[2] Nigel Bruce et al., 'Indoor Air Pollution in Developing Countries: A Major Environmental and Public Health Challenge', *Bulletin of the World Health Organization*, 2000, pp. 1078–92.

[3] John Byrne, Kristen Hughes, Wilson Rickerson and Lado Kurdgelashvili, 'American Policy Conflict in the Greenhouse: Divergent Trends in Federal, State, and Local Green

Energy and Climate Change Policy', *Energy Policy*, vol. 35, 2007, pp. 4555–73.

[4] Joseph Romm, 'The Car and Fuel of the Future', *Energy Policy*, vol. 24, 2006, pp. 2609–14.

[5] 'US Import Bill Set to Top $400 Billion', *Petroleum Intelligence Weekly*, 10 March 2008.

[6] See D.R. Bohi and M.A. Toman, *The Economics of Energy Security* (Boston, MA: Kluwer Academic, 1996), pp. 14–15, 44–5.

[7] *OECD Economic Outlook*, July 1981; see also Robert Stobaugh and Daniel Yergin, *Energy Future: Report of the Energy Project at Harvard Business School* (New York: Ballantine, 1980).

[8] *World Energy Outlook 2007* (Paris: International Energy Agency, 2007).

Sino-American Energy Competition

Michael T. Klare

Nader Elhefnawy provides a rich architecture in which to consider the political, economic and security implications of an eventual contraction in the global supply of petroleum. One need not agree with every aspect of his overall assessment to conclude that a future contraction in supply – whether or not it proves to be as severe as he contends – will have a profound impact on the global security environment.

Elhefnawy acknowledges that there is room for debate in interpretation of the available data on global oil availability, but generally sides with those who believe that an imminent peak in production – to be followed by an inevitable downturn in output – is likely. 'The evidence for a significant, prolonged and continuing contraction in production ... beginning by the 2020s is considerable', he notes. But while this assessment might once have provoked considerable dissent, it is increasingly being viewed as the prevailing norm – especially with crude oil prices exceeding $130 per barrel (as of early June 2008) and the major oil companies reporting both declining rates of output at older fields and few new discoveries to replace them.

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Far more provocative, however, are Elhefnawy's observations on the security implications of an impending contraction in global petroleum supplies. It is here, I suspect, that he will encounter greater skepticism and dispute. These comments are more speculative and, therefore, more subject to criticism. Nevertheless, I believe that many of his findings will survive the test of time. The 'resource curse', for example, is very real, as demonstrated by the current violence in the Niger Delta region of Nigeria; state collapse, a more extreme phenomenon, could well occur in poor countries hit hard by the rising price of oil and food. Other observations might not fare so well, but this remains to be seen; at the very least, he has given us much food for thought.

And yet, for all the valuable insights he provides on the security implications of declining oil supplies, Elhefnawy fails to address the problem I see as the most pressing in this area: the military implications of growing US–Chinese competition for foreign petroleum supplies. Of all the great powers that will be adversely affected by an eventual contraction in the global supply of oil, the United States and the People's Republic of China (PRC) are the ones likely to experience its most severe effects. These nations are the world's leading users of petroleum, jointly accounting for approximately one-third of total world consumption: 28.8m out of a world total of 86.7m b/d, according to the US Department of Energy. The further one looks into the future, moreover, the greater their expected need for oil and the larger their combined share of global consumption: in 2030, predicts the department, their combined usage will have grown to 42.0m b/d, representing 36% of projected world petroleum consumption of 117.3m b/d.[1]

A contraction in global petroleum supplies will have severe consequences for all oil-consuming nations, as Elhefnawy rightly points out. But it will have particularly harsh implications for the United States and China because of the distinctive role oil plays in each. In the United States, oil is the leading source of energy, providing approximately two-fifths of the total supply, and is absolutely essential for transportation, which relies almost exclusively on petroleum-fuelled automobiles, trucks and buses. With its ever-lengthening commute distances and pitifully few passenger-rail services to fall back on, the United States is especially vulnerable to the hardships imposed by dwindling and more costly supplies of oil.

China does not rely on petroleum for as large a share of its net energy supply as does the United States – coal is the leading energy provider in the PRC (with all its attendant environmental problems) – but the government has made petrochemicals and automobile manufacture twin pillars of its industrial expansion and so has generated an ever-growing requirement for oil. According to some estimates, automobile ownership in China is projected to rise from 27m vehicles in 2004 to 400m by 2030, producing a phenomenal increase in petroleum demand.[2] This rise in automobile ownership is not as essential to national transportation as it is in the United States, but it is an important symbol of rising middle-class aspirations and so is something the Chinese leadership has vigorously nurtured, for example, by keeping petroleum prices artificially low. Hence, a contraction in global oil supplies will pose significant political as well as economic problems for Beijing.

All this bears with particular impact on the global security equation because the United States and China are heavily reliant on *imported* oil, and so must compete for access to ever-dwindling overseas supplies. At present, the United States and China are the world's first and third leading oil importers (Japan is number two), obtaining 12.4 and 4.1m b/d from abroad, respectively. But China's oil demand is rising so rapidly that it is soon expected to overtake Japan. By 2030, according to the Department of Energy, the United States will need to import 17.8m b/d and China 11.9m. At that time OECD Europe and Japan will together need to import about 18.5m b/d, so the combined Sino-American import requirement will represent about three-fifths of the total import needs of the world's major economies[3] – a very significant consideration if global petroleum supplies are not growing but rather contracting by that time.

To obtain all of these imported supplies, China and the United States will need to draw upon the same dozen or so major producing countries that possess sufficient petroleum reserves to satisfy their own needs and provide a surplus for export. The list is not long: Algeria, Angola, Libya, Nigeria and Sudan in Africa; Azerbaijan, Kazakhstan and Russia in the former Soviet

Union; Iran, Iraq, Kuwait, Saudi Arabia and the United Arab Emirates in the Gulf region; Venezuela and perhaps Brazil in Latin America. As these suppliers' role in global energy commerce has grown, so, too, has their prominence in the foreign affairs of both the United States and China. Senior American and Chinese officials have made frequent pilgrimages to the national capitals of most of them and invited their leaders to Washington or Beijing for lavish state visits. Typically, these encounters are accompanied by offers of loans, development aid, diplomatic favours or other inducements in return for privileged treatment when it comes to the award of joint ventures or development schemes by these states' national oil companies. Increasingly, however, these inducements also include military packages, and it is in this regard that the security dimension begins to loom large.

Increasingly these inducements include military packages

Looking again at the list of major oil-surplus nations, it is apparent that the governments of many have an obvious requirement for arms and military services, whether to defend against hostile neighbours, to suppress ethnic separatist movements, or to defend themselves against those compatriots who might seek to replace them. It is not surprising, then, that these governments would welcome such assistance from their oil-seeking suitors. And their suitors have, in turn, been more than happy to oblige: as part of their burgeoning ties with these countries, both the United States and China have become major suppliers of arms and military services to many of the countries listed above. The United States, for example, is an arms supplier to Angola, Azerbaijan, Iraq, Kazakhstan, Kuwait, Nigeria, Saudi Arabia and the United Arab Emirates; China is a supplier to Angola, Kazakhstan, Iran, Nigeria, Saudi Arabia and Sudan.[4]

The result is an accelerated flow of arms and military equipment into areas that, in many cases, are suffering from internal or regional friction and conflict. In some cases, this could lead to a greater propensity on the part of central governments to employ force rather than engage in political dialogue when dealing with domestic opposition movements or ethnic separatists, a pattern seen in Sudan and Nigeria. It could also help spark regional arms races. In the Gulf, for example, Chinese and Russian arms sales to Iran have been countered in recent months by stepped-up US military deliveries to Saudi Arabia and other members of the Gulf Cooperation Council. Both phenomena could contribute to the further erosion of stability in the developing world along the lines sketched by Elhefnawy.

The greater danger, however, is that this will lead to increased friction between the United States and China. This will arise as leaders of both countries perceive the respective arms diplomacy of their rival as a threat to their own national-security interests. This perception has, in fact, already begun to take root. Recent editions of the *Military Power of the People's Republic of China*, an annual report prepared by the US Department of Defense, have warned of growing Chinese military ties with key energy and mineral producers in the developing world. 'Securing adequate supplies of resources and materials has become a major driver of Chinese foreign policy', the 2006 edition noted, an impulse that has led Beijing to shower favoured suppliers like Angola, Sudan and Zimbabwe with arms and military technology.[5]

Chinese officials appear to harbour similar concerns about the United States. In particular, Beijing worries about US efforts to establish military ties with the former Soviet republics of Central Asia. These ties were first established during the Bill Clinton administration, when US oil companies acquired substantial production rights in Kazakhstan and pursued similar rights in Turkmenistan. Concerned over the unsettled security environment in the Caspian Sea basin and the risks this posed to the safe transport of Caspian energy, President Clinton oversaw the initiation of US military-aid agreements with Kazakhstan, Kyrgyzstan and Uzbekistan. Following the 11 September terrorist attacks, President George W. Bush built on these relationships to establish US bases in Kyrgyzstan and Uzbekistan, further expanding the US military presence in the area. Now Beijing, working in concert with Moscow and the Shanghai Cooperation Organisation (SCO), seeks to reverse this trend and diminish the US presence in the region. In the most conspicuous expression of this outlook to date, Chinese forces participated last summer in elaborate multilateral military manoeuvres intended to demonstrate the organisation's self reliance. 'The SCO nations have a clear understanding of the threats faced by the region and thus must ensure their security themselves', Chinese President Hu Jintao declared at the time, a clear signal that the United States was not needed – and not wanted – in the region.[6]

These concerns also appear to be guiding the military planning of the two countries. In February 2007, for example, the United States announced the establishment of a new headquarters organisation to oversee US forces operating in Africa, the US Africa Command or AFRICOM. Although not publicly citing Chinese military involvement in the region as a motive for creation of the new command, Department of Defense officials have acknowledged privately that this is a factor. In a PowerPoint presentation at the National Defense University in February, AFRICOM's deputy commander, Vice-Admiral Robert Moeller, indicated that among the key challenges to US strategic interests in the region is China's 'growing influence in Africa'.[7]

For its part, China's growing military assertiveness is perhaps best reflected in the expansion of its deep-sea naval capabilities and its more conspicuous military role in the Shanghai Cooperation Organisation – a point noted by Elhefnawy. In the exercises last summer, for example, Chinese airborne forces engaged in military manoeuvres outside Chinese territory for the first time ever.

These endeavours are likely to gain momentum in the years ahead as both China and the United States become ever more dependent on the oil reserves of Africa, the Middle East and Central Asia and as their competitive drive for access to what remains of these supplies intensifies. It is conceivable that such efforts will lead, in time, to an unintended clash between American and Chinese forces, provoking an international crisis and possibly war. Certainly, at present, with the leaders of all great powers grimly aware of the risks of a major inter-state conflict, the probability of such a confrontation has to be considered very low. This does not mean, however, that US and Chinese leaders are not prepared to devote enormous resources to *preparation* for such an eventuality. In fact, both countries have recently announced significant increases in military spending with heavy emphasis on the sort of forces – advanced air, naval and missile capabilities – one would anticipate using in a future engagement between them. In US budget justifications, moreover, China (that is, a better-equipped and more menacing China of the future) is often cited as a likely future adversary of the United States. One assumes that Chinese budget documents make similar assumptions about the United States, but these are not normally made public.

In the end, it may be the *financial* implications of all this that will prove most harmful. As Elhefnawy rightly concludes, vast sums will be needed to develop climate-friendly energy sources to replace disappearing stocks of petroleum in the coming decades, and much of this largesse will have to be provided by governments. This, in turn, will require an awareness by policymakers that addressing the global energy crisis is a top governmental priority and must entail a substantial mobilisation of scientific, industrial and capital resources. Clearly, the outbreak of a Sino-American arms race will drain both attention and resources away from this sort of mobilisation. It is this outcome that we must fear the most.

Notes

[1] US Department of Energy, Energy Information Administration, *Annual Energy Outlook* 2008, Table 20, International Petroleum Supply and Disposition Summary, available at http://www.eia.doe.gov. These figures obviously do not take account of the oil-production declines predicted by Elhafnawy; they do, however, incorporate liquids derived from Canadian tar sands, biofuels and other nonconventional sources.

[2] US Department of Defense, *The Military Power of the People's Republic of China 2008* (Washington DC: Department of Defense, 2008), p. 10.

[3] US Department of Energy, Energy Information Administration, *Annual Energy Outlook 2008*, Table 20.

[4] See Michael T. Klare, *Rising Powers, Shrinking Planet: The New Geopolitics of Energy* (New York: Metropolitan Books, 2008).

[5] US Department of Defense, *The Military Power of the People's Republic of China 2006* (Washington DC: Department of Defense, 2006, p. 1.

[6] Quoted in the *Guardian*, 17 August 2007.

[7] Robert Moeller, 'United States Central Command', PowerPoint presentation, National Defense University, Washington DC, 19 February 2008, available at http://www.ndu.edu/ctnsp/NCW_course/Moeller_08%20 02%2014%20DCMO%20Brf%20v2.pdf.

Response

Nader Elhefnawy

I would like to start by thanking Amy Myers Jaffe and Michael T. Klare for their comments regarding my article. While they agree with many points of my assessment, they also point to a number of items they find problematic. Jaffe argues that I have underestimated the flexibility of the market and the prospects for peaceful adaptation to the new conditions, particularly by the United States. Klare suggests I did not give sufficient attention to the prospects of a Sino-American military competition, to which energy politics is already contributing.

Jaffe observes that 'investors in alternative energy ... in Elhefnawy's world could invest far more capital without any fear that fossil fuels would fight back'. The article focused on long-term energy *security*, rather than financial advice to investors, and therefore warranted a more cautious consideration of the issue, extending to an examination of worst-case scenarios. Nonetheless, Jaffe's characterisation of my position is not entirely inaccurate. The flexibility of markets is not infinite, and natural-resource scarcities remain an important limitation on their capacity for generating solutions.[1] A return to 'cheap oil' (a problematic concept in itself) is no exception. All the signs – the smaller size of newly discovered deposits, the growing shortfall between new discoveries and the depletion of proven supplies, the emphasis on areas where exploration and extraction are more difficult and costly (like offshore fields), the broadly falling energy return on energy invested (EROEI) – strongly indicate a trend toward diminishing marginal returns on investment in oil production. The relatively slow process of enlarging oil production is also a factor, deferring even the hope of a price drop to a point at which this trend will be even more advanced.

Of course, cutbacks in consumption driven by high prices could help in the interim. However, energy consumption is relatively inelastic, and the

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energy shortages of the 1970s did not cause consumers to fundamentally reduce their use. Rather, high prices temporarily held down growth in consumption. Substantial, lasting reductions require structural changes like the conversion of infrastructure and vehicle fleets, which tend to be gradual when driven by the market.

Moreover, energy efficiency may also be an area of diminishing marginal returns on investment. While the rise in global energy efficiency in the 1990s (measured in terms of the energy input needed to produce a unit of gross domestic product) kept pace with the progress of the 1970s and 1980s (about 10% per decade), the distribution of the gains of the years 1990–2003 is cause for concern.[2] It was concentrated not among advanced states, but those rated 'lower middle income' by the World Bank – economies which in the natural course of development did away with very easy inefficiencies, rather than pushing the envelope.[3]

In fact, the most efficient among the large states saw their improvement stagnate during these years; the progress of Japan and Italy, in particular, was flat.[4] The more impressive gains of Germany, Britain and the United States are likely due to how far behind they were to begin with – these are 'easy' gains, as in the case of many developing nations.[5] This trend might be attributable to low oil prices affording little incentive to make a greater effort, but that remains speculative. The booms and busts Jaffe mentions as comparable to this decade's should also be examined closely. The 1956 crisis was due to the closure of the Suez Canal. The oil shocks of 1973 and 1979 involved concerted action by the Organisation of Petroleum Exporting Countries (OPEC). The 1990 shock was a result of UN sanctions taking Iraqi and Kuwaiti production offline.

In short, all four shocks were partly attributable to deliberate political decisions regarding oil production, transportation or price, to which the 2003 shock offers no analogue. It is also worth remembering that prices tended to fall through the 1980s and 1990s despite the Iran–Iraq War, sanctions against Iraq and periodic war scares in the Persian Gulf, and reached their low point in 1998, a particularly anxious year where Iraq's relationships with the UN and the United States were concerned. The ongoing war in Iraq and international tensions regarding Iran's nuclear programme therefore seem insufficient to account for the current prices ($138 a barrel), which exceed the earlier 1981 record by over 40% in real terms.

The real issue is that oil producers have less slack for absorbing shocks of all kinds. Rising consumption in Asia is certainly a factor, but still leaves the question of why producers have failed to keep up. That failure can partly be attributed to a fixation on short-term profit-seeking, but also reflecting the diminishing marginal returns that make rectifying the situation more difficult.

This is not to say that oil cannot 'fight back'. Declines rarely follow a straight downward trajectory, but the curve gets much steeper, and it becomes reasonable to expect that those who do fight back will give more and get less. It only muddles the issue to say that prices will at some point go down. A more appropriate question is how much can we reasonably expect them to go down, and for how long before prices start to go back up again. For instance, will prices return to the low of the 1990s, when they hit $10 a barrel – a drop of 90% from today's prices, after adjustment for inflation? Will they even come close?

That seems unlikely. When oil fought back against alternatives in the past, it did so politically as well as through the market. Where renewable energy should have enjoyed the protected status of an 'infant industry' on the grounds of energy independence and ecology, such support was withdrawn in the United States in the early 1980s.[6] While this was done in the name of the free market, renewable energy did not compete on a level playing field but one tilted in favour of fossil fuels, the beneficiary of a long and ongoing history of subsidy.[7] Fossil-fuel-related R&D was funded by the government at four times the level of renewable energy for the 1972–95 period.[8] Such subsidies make the 'cheap' oil to which Jaffe refers illusory in an important sense (even without considering problematic externalities like climate change, which Jaffe rightly raises).

The relative cost of renewable energy has steadily dropped

Despite these disadvantages, the cost of renewable-energy production has steadily dropped relative to oil since the 1970s, so that wind is increasingly competitive. Given recent experience, this trend can be expected to continue (though not indefinitely). A true repeat of the late 1980s and 1990s with regard to the energy markets is thus highly unlikely, barring perverse public-policy decisions.

However, while Jaffe characterises my assessment as a 'doomsday scenario' at which future readers will scoff, the parameters laid down here leave a wide range of possibilities with regard to the speed with which that scarcity develops, the severity of the resulting problems, and the room for manoeuvre actors will have in which to adapt to the new situation. Peaceful, progressive responses are conceivable, and one can point to real achievements. Denmark, for instance, derives a fifth of its electricity from wind energy, and reduced its fossil-fuel use by a comparable margin in the 2001–05 period, all while maintaining one of the highest living standards in the world.[9] Unfortunately, Denmark is the exception rather than the rule; others are proving slow to follow, and even were the propensity to do so greater, not all countries can adapt as easily. Considerable variation exists in this respect among even the advanced industrial countries.

This brings me to the second major point, the case of the United States. As Jaffe notes, America's status as the world's single biggest consumer of energy and oil positions it to have a greater positive impact on the situation than any other single actor. It is also the world's biggest spender on technological R&D, and has enormous potential to produce energy from photovoltaic solar, wind and other renewable sources.[10] All these resources can be mobilised to meet the challenge.

Nonetheless, the United States has further to go than other developed nations, and a number of particularly severe obstacles to overcome. These include the country's overall low energy efficiency, underdeveloped renewable-energy industry, and a 'culture of oil' deeply embedded in national attitudes, consumer habits and physical infrastructure. The US economy may also not be as robust as it appears, and is already suffering the consequences of its de-industrialisation and trade deficits (possibly coming to a head in a currency crisis), which complicate adaptation.

Meaningful action on all these issues will take considerable political will, extending to a fundamental rethinking of the economic legacy of the 1980s.

There is little sign of this as yet, neither at the level of federal policy (though many US states and even localities have been more active), nor in public discourse about the issue, which remains mired in inoffensive platitudes. I am not arguing for economic determinism, but taken together these factors threaten America's position as a global power.

The issue of global-power status, of course, raises Klare's concern over the risk of military competition between the United States and China. I agree that China, along with the United States, will be the major country most adversely affected by contracting oil supplies. China's robust growth, strong currency and heterodox economic policies have, for the time being, constrained the effect of oil-price rises on its economy (just as they constrained the effects of the 1997–98 Asian financial crisis). However, over the long term, deepening scarcity will take its toll.

Klare is also right to note China's support of its energy policy with diplomacy and arms sales in recent years; the resulting frictions with US interests in Central Asia and elsewhere; and the danger not only of an increased risk of a great-power military clash, but the resulting diversion of resources and attention away from more useful investments. Indeed, the pursuit of energy security through military means has already exacted a high price. What might the United States have accomplished if it put even a small fraction of the money spent on securing the Persian Gulf since 1973 into developing alternate energy sources?

Nonetheless, a few qualifiers are in order, particularly where China's position is concerned. The country's wealth, capabilities and prospects are constantly exaggerated. Despite its lengthy investment in military modernisation, China still lacks the power-projection assets of the United Kingdom, let alone the United States. Additionally, while China's relationships with Iran and Sudan rightly raise eyebrows, it is significant that China has become more cautious in pressing its claims in the South China Sea basin since 2001, a situation much closer to home, and where it is far stronger than in the distant Middle East. Indeed, China relies much less on its military resources internationally than the softer power generated by its economic standing and its effective diplomacy, exploiting the desire for a counterweight among those discontented with US foreign policy.[11]

This does not rule out a more militarised and confrontational Chinese policy in the future, but the constraints here are greater than many observers realise. The situation will be slow to change, in part because, energy portfolio apart, China's economy, too, is not as strong as it appears. According to a report issued by the Asian Development Bank last year, the miscalculation of purchasing power parity for China may have led to an overestimate of the size of China's economy by 40%, an assessment now widely accepted.[12] In short, China is several years behind the position the most optimistic estimates have given it, and much else about its economic performance is also called into question by this rethinking.

China's economic progress has also exacted an appalling social and ecological price. The desertification, air pollution and fouling of the Yellow and Yangtze rivers, and the sharp cleavages between regions and classes (manifest in rural unemployed migrating toward the cities), all bode poorly for the sustainability of China's current course. Those who criticise Europe's trend toward an older population would also do well to remember that China is one of the most rapidly ageing countries in the world.

Indeed, China's condition not only invites comparison with the rise of great powers like the United States, but frustrated ascents to superpower status, like the 'Brazilian miracle' of the 1970s, which astonished the world – as China astonishes now – before fizzling out. China's collapse, rather than a lengthy arms race, may in fact be a more likely consequence of its reliance on oil, though these unfortunate paths are not mutually exclusive.

The optimal future is one in which, as Jaffe argues, the United States and China (and other economic powers like the EU and Japan) lead the international community in a project to improve energy efficiency, build up production from already viable and increasingly attractive alternatives, and further develop the technological state of the art in energy production and use, while extending the benefits of these to even the poorest nations. Sadly, however, the rational course is not the only one possible, or even the most likely. There were wide hopes of a similar venture 35 years ago in the wake of the OPEC embargo, but for all the bold rhetoric of the Nixon and Carter administrations, the results of American efforts in particular were dismal. It would be folly to ignore this dismaying precedent, and unfortunately the policy of the United States and China in recent years has not been much more encouraging. A humane and successful response to the problem is well worth working for, but it cannot be taken for granted.

Notes

[1] Thomas Homer-Dixon, *Environmental Scarcity and Global Security* (Ithaca, NY: Foreign Policy Association, 1993), pp. 67–8.

[2] World Bank, *2006 World Development Indicators* (Washington DC: World Bank, 2006), pp. 158–60.

[3] *Ibid*.

[4] *Ibid*., pp. 158–60.

[5] *Ibid*.

[6] Nader Elhefnawy, 'Toward a Long-Range Energy Security Policy', *Parameters*, vol. 36, no. 1, Spring 2006, pp. 108–10.

[7] *Ibid*.

[8] Fred J. Sissine, 'Energy Efficiency: A New National Outlook?' *Congressional Research Service Reports*, 12 December 1996, http://www.cnie.org/nle/crsreports/energy/eng-28.cfm.

[9] In 2005, Denmark was consuming 20% less oil daily than it was in 2001, and 37% less than in 1981. US Energy Information Administration, 'World Petroleum Consumption', *International Energy Annual 2005*, 6 August 2007, available at http://www.eia.doe.gov/pub/international/iealf/table12.xls. Danish coal and natural-gas consumption have also trended downward.

[10] Robert L. Paarlberg, 'Knowledge as Power: Science, Military Dominance and U.S. Security', *International Security*, vol. 29, no. 1, Summer 2004, pp. 122–51.

[11] Chris Zambelis and Brandon Gentry, 'China through Arab Eyes: American Influence in the Middle East', *Parameters*, vol. 38, no. 1, Spring 2008, pp. 60–72.

[12] See Albert Keidel, 'The Limits of a Smaller, Poorer China', *Financial Times*, 14 November 2007, http://www.carnegieendowment.org/publications/index.cfm?fa=view&id=19709&prog=zch. Between 2007 and 2008, the CIA revised its estimate of China's GDP down from $10 trillion to $7tr. See the 2007 and 2008 editions of the Central Intelligence Agency's *CIA World Factbook*.